

DEPARTMENT OF THE AIR FORCE
AIR FORCE FLIGHT STANDARDS AGENCY
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AT-E-12

AIR TRAFFIC CONTROL TRAINING SERIES



EQUIPMENT

AN/GPN-22
HANDBOOK

28 July 1993

FOREWORD

PURPOSE. This publication is designed for training USAF air traffic controllers and is not intended to replace, substitute for, or supersede official regulations, procedures, or directives.

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Supersedes ATE12 October 1986
OPR: AFFSA ATSC/DO
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INTRODUCTION

This publication is designed to be used in conjunction with hands on training and classroom instruction to train air traffic controllers on the operation of the AN/GPN- 22 (HI PAR). It may contain modifications not applicable at your location. It does not replace TO 31P5-2GPN 24-11 (Operators Handbook) or applicable maintenance technical orders which are the official directives for this equipment.

GENERAL

The AN/GPN -22 detects and tracks aircraft approaching a runway for landing. The antenna is mounted on a pedestal, permitting it to be rotated, up to 270 degrees. It is capable of providing service to any of four preselected runways. Full precision coverage may be viewed continuously by final controllers. This single radar system is actually two radars in one. It is a search radar which constantly scans the entire area of coverage and a tracking radar capable of tracking as many as six targets simultaneously.

The HI PAR system generates data which displays the position of aircraft relative to the course and glide path of a selected runway. The data displayed includes: normal video of aircraft in the antenna scan; synthetically generated symbols designating the locations of up to six aircraft that can be tracked during final approach; history of tracked aircraft over a 3 minute interval; and the glidepath, decision height and safety zone markers specified for the selected runway. This handbook is divided into five chapters:

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ABBREVIATIONS

The following abbreviations are used in this publication. Combinations of these abbreviations may be used.

ABBREVIATION	FULL NAME
ABPC	Antenna Beam Position Control
ACCUR	Accuracy
ACQ	Acquire
ACQ GAIN--HI/LOW	Acquisition Gain--High/Low
ADJ	Adjust
AVAIL	Available
BRT	Brightness
CCW	Counterclockwise
CHAN	Channel
CRT	Cathode Ray Tube
CTNG	Centering
CTR	Center
CW	Clockwise
DES	Designate
EPROM	Erasable Programmable Read Only Memory
FCTN	Function
FTC	Fast Time Constant
GRD	Ground
HI-PAR	High Performance Precision Approach Radar
HPWR	High Power
INCR	Increase
IND	Indicator
INIT	Initiate
INT	Intensity
MARG	Marginal
MHZ	Megahertz
MTI	Moving Target Indicator
NORM	Normal
LPWR	Low Power
OPS	Operations
PAR	Precision Approach Radar
PERF	Performance
PHT	Preheat
PNL	Panel
RAD	Radiate
RAPCON	Radar Approach Control
RCVR	Receiver
RDR CON	Radar Control
REJ	Reject
RNG	Range
RNG MK INT	Range Mark Intensity
RSC	Radar Set Control
RWY	Runway
SENS	Sensitivity
STAR	Second Time Around Rejection
STBY	Standby
TD	Touchdown
TDC	Target Data Computer
TEMP	Temperature
TRK	Track

GLOSSARY OF TERMS

Angle of Beam - The angle which encloses the greater part of the energy transmitted from a directional antenna system.

Bandwidth - A certain range of frequencies within a band.

Bore Sight - Alignment of a directional radar system, using a fixed target at a known location.

Bus - A circuit over which data or power is transmitted.

Clutter - The display of unwanted radar signals.

Coherent MTI - Used to discriminate between aircraft returns and reflections from fixed and slowly moving clutter.

Fast Time Constant - A feature used to break up areas of clutter, including heavy precipitation. Allows only the leading edge of targets to be presented on the indicator.

Fault - A physical condition that causes a device, component or element to fail to perform properly.

Gain - Control used to vary the intensity of Radar returns for both MTI and normal video.

Gated Sweep - A sweep in which the duration, and starting time, is controlled to exclude undesired echoes from the indicator display.

Megahertz - A unit equal to one million cycles per second.

Moving Target Indicator - A feature which shows only targets in motion.

Noncoherent MTI - Used to discriminate between aircraft returns and reflections from rain and/or chaff.

Normal Radar - That radar presentation which displays all radar targets both moving and stationary, as opposed to MTI radar.

Range - The number of miles between the antenna and a target, measured in nautical miles.

Reflector - A metal device of triangular or round shape used for the purpose of providing a strong radar echo or pulse from a known position.

Scan Area - That area in space covered by the radar antenna pattern.

Second Time Around Echo - An echo received after an interval exceeding the pulse interval.

Segment - That portion of a computer routine or subroutine that can be completely stored in the internal storage of the computer and containing the necessary instructions to jump to another segment.

Sensitivity - Time Control - This control allows full target strength at distant ranges while reducing target signal strength at close ranges.

Snow - A speckled background caused by random noise on an intensity-modulated cathode ray tube.



3. **OVER TEMP** indicator lamp is used to alert you when an overheat condition is detected in the radar data transfer group power supply or the ops display power supplies.



4. **FAULT** indicator lamp is used to alert you when a fault is detected in the ops radar data transfer group power supply or the ops display power supplies.

CONTROL INDICATOR	LAMP INDICATION	MEANIN	REMARKS
OVER TEMP	OFF	Normal operation	
	Yellow	Overheat condition detected in either the ops radar data transfer group power supply or the ops display power supplies.	Set MODE -OFF control (located on display console) to OFF and notify maintenance.
FAULT	OFF	Normal operation	
	Red	Fault is detected in the ops radar data transfer group power supply or the ops display power supplies.	Notify Maintenance

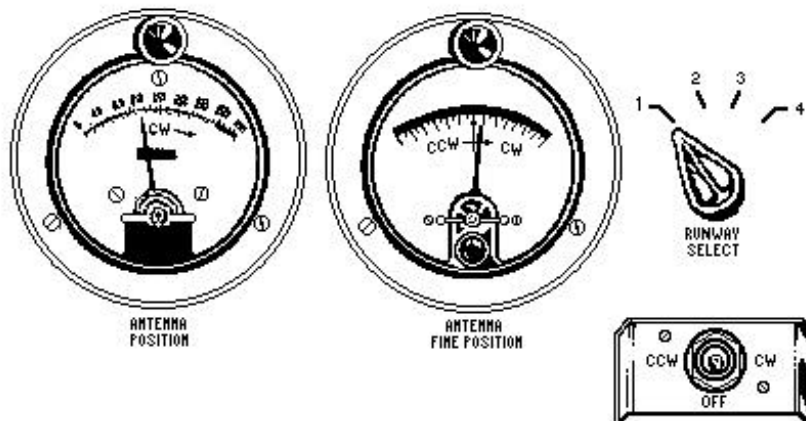
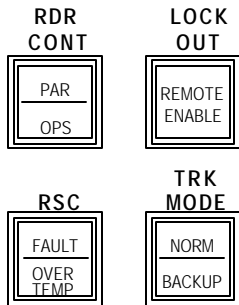


Figure 1-2. Runway Select Control.

5. **RUNWAY SELECT** control is a four-position dial used to select one of four preset runways.
6. **CCW-OFF-CW** control is a three-position toggle switch used to rotate the HI-PAR antenna to the selected runway. This control is spring loaded to the center position.
7. **ANTENNA POSITION** meter is used to determine when the HI-PAR antenna is roughly aligned to the selected runway.
8. **ANTENNA FINE POSITION** meter is used to determine when the HI-PAR antenna is fine aligned to the selected runway.
9. **RDR CONT PAR/OPS** indicator is a two-position lamp used to identify the section that has control of the radar.

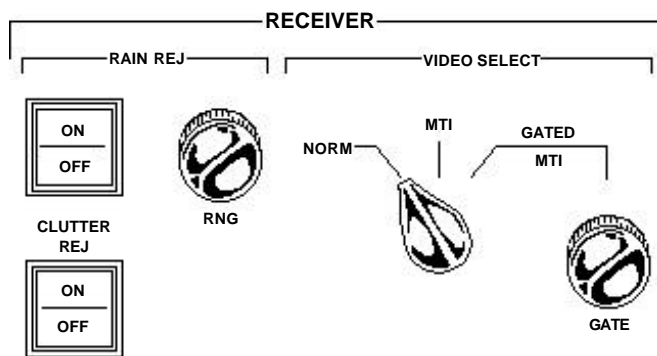


10. **LOCKOUT-REMOTE ENABLE** push-button control prevents maintenance from taking control of the HI-PAR without your approval and action. This button must be activated before control can be transferred from the Ops to PAR segment. During normal operation the lamp should be white to prevent maintenance personnel from inadvertently taking control of the system.

11. **TRK MODE-NORM/BACKUP** control is a two-position pushbutton switch-lamp used to enhance returns from small targets. The scan rate is reduced by half in the backup mode causing the normal (scan) target to be enhanced. The backup mode was designed to be used when the tracking function is lost due to a weak return.

CONTROL INDICATOR	LAMP INDICATION	MEANING	REMARKS
RDR CONT PAR/OPS	Upper Section White	PAR segment has control	
	Lower Section White	OPS segment has control	
LOCKOUT REMOTE ENABLE	Green	Control can be transferred from the OPS to PAR segment.	
	White	Control cannot be transferred from the Ops to PAR segment.	

RSC-FAULT OVER TEMP	Upper Section Red	Fault detected in refresh memory power supply.	Notify Maintenance
	Lower Section Yellow	Overheat condition in refresh memory power supply.	Notify Maintenance
TRK MODE NORM/BACKUP	Upper Section Green	Normal acquisition.	Depress button once to change to backup
	Lower Section Green	System in backup mode	mode.



13. **RAIN REJ-ON/OFF** control is a two - position pushbutton lame. Since it is a function of MTI, it works only when MTI or GATED MTI is selected. When activated, RAIN REJ places noncoherent MTI into the system and also activates the RNG ADJ control and allows you to gate the noncoherent MTI at the desired range.

14. **CLUTTER REJ** control is a two -position pushbutton lamp used to eliminate second time around (STAR) target returns. This function does not eliminate normal clutter from the display. Unless STAR targets have been identified, this control will be off during normal operations.

NOTE: STAR returns will normally be identified during the commissioning process.

CONTROL INDICATION	LAMP INDICATION	MEANING	REMARKS
RAIN REJ ON/OFF	Upper Section Green	Function is ON	Depress button to turn the function ON/OFF
	Lower Section White	Function is OFF	
CLUTTER REJ	Upper Section Green	Function is ON	Depress button to turn function ON/OFF
	Lower Section White	Function is OFF	

15. **RNG** control knob varies the range of noncoherent MTI when the RAIN REJ function is activated.

16. **VIDEO SELECT** control is a three position dial used to select the type of video desired. i.e. Normal, MTI, or GATED MTI.

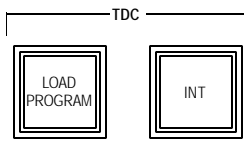
NOTE: You cannot select noncoherent MTI with this control.

17. **RNG GATE** control knob varies the range of MTI video when the RECEIVER-VIDEO SELECT knob is set to GATED MTI.



18. **PAR PERF/TEST** control is a two position push button lamp used for testing the performance of the radar tracking circuits

19. **MARGINAL PERF/TEST** control is a two position push button lamp which continues testing the radar tracking circuits with increased power output.

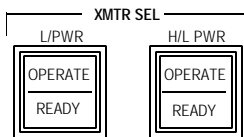


20. **TDC-INIT** control is a push button lamp used to correct a suspected program fault in the TARGET DATA COMPUTER. The button has a spring loaded clear plastic guard to prevent accidental activation.

NOTE: When this control is activated, all tracked targets will be dropped to an untracked status, and both indicators must be verified.

21. **TDC LOAD PROGRAM** control is a pushbutton lamp that is activated when TDC INITIATE does not correct the fault in the TARGET DATA COMPUTER. This button also has a spring loaded guard to prevent accidental activation.

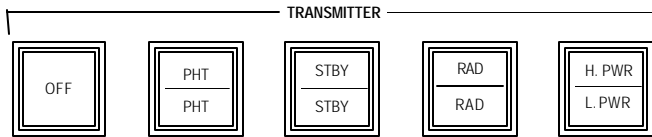
NOTE: After reading the program into the computer, the tape reader must be reloaded by maintenance at the PAR shelter. Push the button only once. If you activate the control again before it's reloaded, the tape will run off the spool onto the floor and must be reloaded by hand. The indicator must be verified after the program is entered into the computer.



22. **XMTR SEL-L/PWR OPERATE/READY** control is a two position push button switch/lamp used to set the LOW power transmitter (1A201) under the control of the RSC.

23. **XMTR SEL H/L PWR OPERATE/READY** control is a two position push button switch/lamp used to set the HIGH/LOW power transmitter (1A19) under control of the RSC.

CONTROL INDICATION	LAMP INDICATION	MEANING	REMARKS
PAR PERF/TEST	Upper Section White/Lower Section OFF	Normal operation	Depress button to activate this function.
	Upper Section OFF/ Lower Section Green	Test mode	
MARGINAL PERF/TEST	Upper Section White/Lower Section OFF	Normal operation	Depress button to activate this function.
	Upper Section OFF/Lower Section Green	Test mode	
TDC-INIT	White	Function is available activate this function.	Depress button once to
TDC LOAD PROGRAM	White	Function is available	Depress button to activate function.
		NOTE: Anytime this but- ton is activated, main- tenance must be noti- fied.	
XMTR SEL L/PWR OPERATE/ READY	Upper Section Green	Low Power transmitter is available.	Press button to activate function.
	Lower Section Yellow	Low power transmit- ter is selected as redundant transmitter.	Press button to activate function.
XMTR SEL H/L OPERATE/ READY	Upper Section Green	High/Low power transmitter is available.	Press button to activate function.
	Lower Section Yellow	High/Low power transmitter is selected as redundant transmitter.	Press button to activate function.



24. **TRANSMITTER-OFF** control is a pushbutton lamp used to shut off the transmitter.

25. **TRANSMITTER -PHT** indicator is a two-position lamp which identifies the current transmitter preheat cycle (5 minute preheat period).

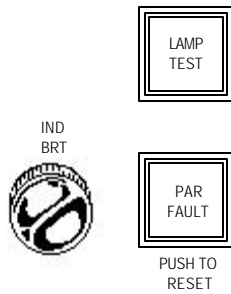
26. **TRANSMITTER-STBY** control is a two-position pushbutton lamp used to set the transmitter in either low or high standby.

27. **TRANSMITTER-RAD** control is a two-position pushbutton lamp used to set the transmitter in the radiate mode.

28. **TRANSMITTER/HPWR/LPWR** control is a two-position pushbutton lamp used to change from one power setting to another.

NOTE: To select low power, you must activate each lamp in sequence starting at PHT. When going to high power, you need only activate HPWR, the system will cycle through each stage automatically. Turn the transmitter off only when instructed to do so by supervisory personnel.

CONTROL INDICATION	LAMP INDICATION	MEANING	REMARKS
TRANSMITTER OFF	White	Function is OFF off.	Depress button once to turn transmitter
TRANSMITTER-PHT	Upper Section White	High power preheat cycle in progress.	
	Lower Section White	Low power preheat cycle in progress.	
TRANSMITTER-STBY	Upper Section Green	High power standby mode to another.	Depress button once to change from one
	Lower Section Green	Low power standby	
TRANSMITTER-RAD	Upper Section Green	High power mode mode to another.	Depress button once to change from one
	Lower Section Green	Low power mode	
TRANSMITTER-HPWR/LPWR	Upper Section White	High power mode mode to another.	Depress button once to change from one
	Lower Section White	Low power mode	



29. **IND BRT** control knob varies the intensity of the indicators and pushbutton lamps on the RSC.

30. **LAMP TEST** control is a pushbutton lamp used to check for burned out bulbs on the RSC.

31. **PAR FAULT** control is a momentary pushbutton lamp used to alert you when a fault is detected in the PAR segment. The button is activated to clear the fault.

CONTROL INDICATION	LAMP INDICATION	MEANING	REMARKS
LAMP TEST	White	Function available	Depress button to activate this function
PAR FAULT	OFF	Normal operation	
	Red	Fault is detected by the	fault circuits in the HI-PAR segment. Depress and release the function to clear the fault. If the PAR FAULT indicator does not extinguish, notify maintenance immediately.
			NOTE: If the PAR FAULT light comes on but the display remains normal, continue to control traffic and notify maintenance.

SECTION B - DISPLAYCONSOLE

32. There are two display consoles located in the operations room. Each of these displays is independent of each other.

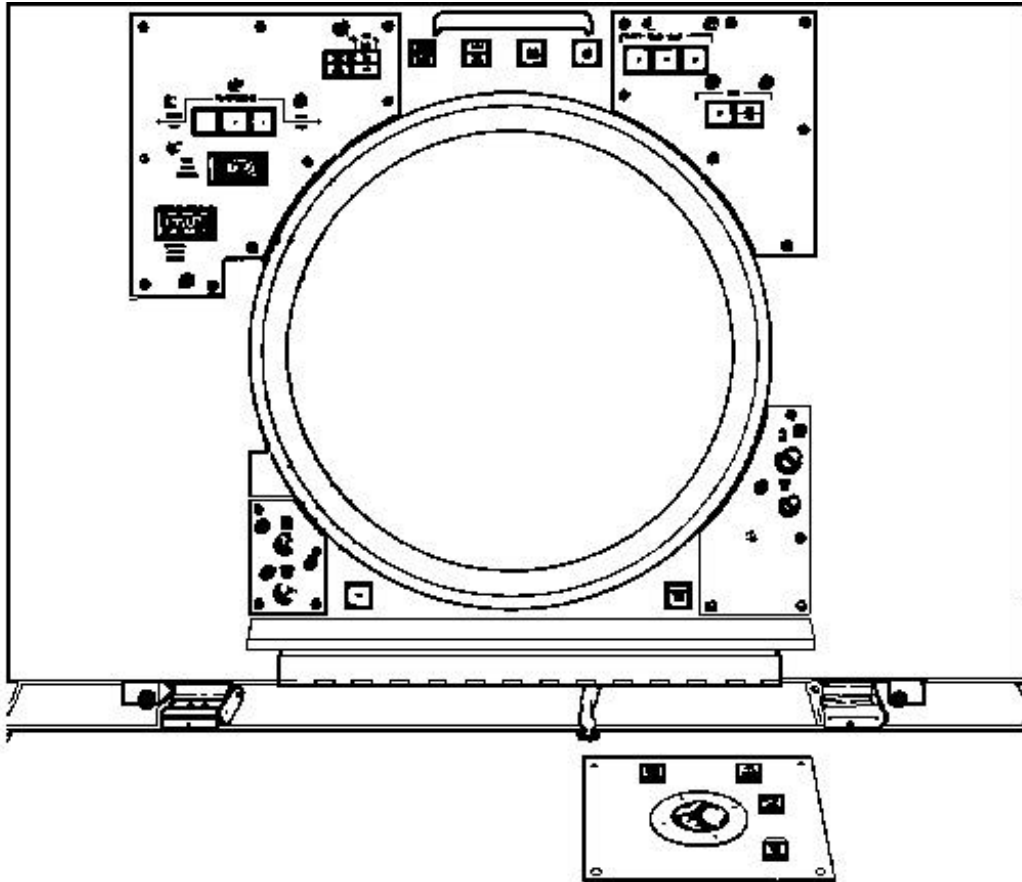


Figure 1-3. Display Console

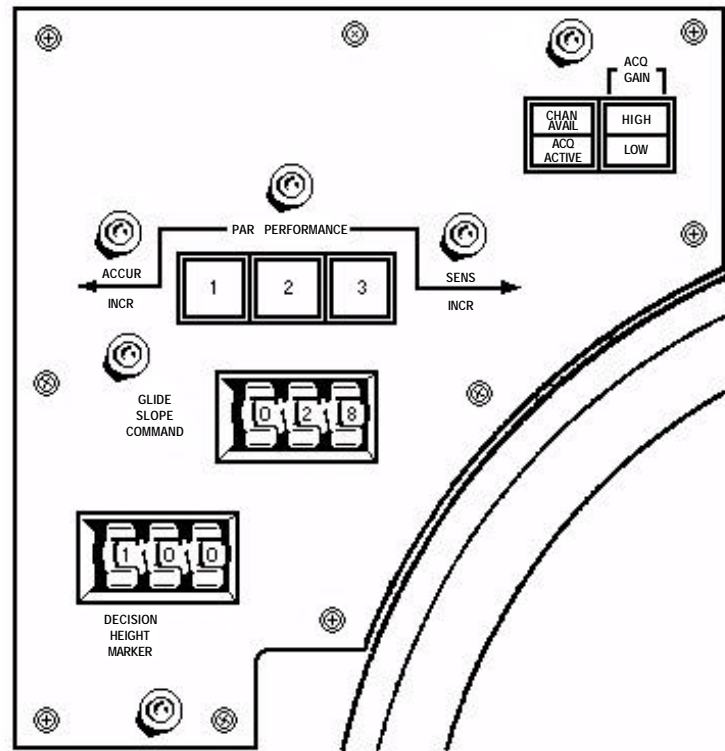


FIGURE 1-4. Top Left Section of Display Console.

33. **DECISION HEIGHT MARKER** is a three-digit thumb wheel dial. It is used to select the altitude of the decision height marker on the display from 0 to 890 feet above the touchdown point in 10-foot increments. This control is set to the landing requirements of the particular runway.
34. **GLIDE SLOPE COMMAND** is a three-digit thumb-wheel dial. It is used to select the final approach glide slope angle from 2 to 5 degrees in 0.1 degree increments. The control is set to the landing requirements of the particular runway.
35. **PAR PERFORMANCE 1/2/3** control consists of three pushbutton lamps. These controls allow you to select a wide, medium or narrow bandwidth based on varying circumstances, such as weather, position and direction of the aircraft.
36. **CHAN AVAIL/ACQ ACTIVE** indicator is a two -position lamp which identifies the status of the Target Data Computer. Up to six track channels are available at any one time.
37. **ACQ GAIN -HI/LOW** control is a two -position switch -lamp used to vary the gain of scan video. When the LOW position is selected, returns from targets with large cross sectional areas are reduced, preventing receiver saturation. Selecting the HIGH position increases the systems ability to acquire small targets.

CONTROL INDICATION	LAMP INDICATION	MEANING	REMARKS
PAR PERFORMANCE 1/2/3	Green	Function selected	Depress button once for desired function. Operates only after a target is acquired.
CHAN AVAIL/ACQ ACTIVE	Upper Section Green. Lower Section Off.	Track Channels available	
	Upper Section Green. Lower Section Green approximately 4 seconds.	Target Data Computer is responding to the acquire target command for a close control tracking.	You must wait until the trip is green before acquiring a target.
	Upper and Lower Section OFF	All six track channels are in use.	
ACQ GAIN-HIGH/LOW	Upper Section Green. Lower Section OFF	High gain on	Depress button once to change from one mode to another.
	Upper Section OFF. Lower Section Green	Low gain on	

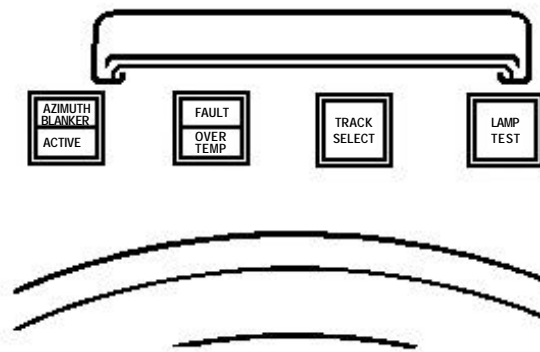


Figure 1-5. Top Center of Display Console.

38. **AZIMUTH BLANKER/ACTIVE** control is a two-position pushbutton lamp used to eliminate second time around clutter which appears at the same range as normal clutter. The area to be blanked should be determined at installation and then verified by having an aircraft fly through the blanked area to ensure you can track the aircraft in both elevation and azimuth.

39. **FAULT/OVERTEMP** indicator is a two-position lamp used to alert you to a failure in the display power supply or a critical temperature rise and possible circuit damage in the equipment.

40. **TRACK SELECT** control is a pushbutton lamp used to change close control tracking from one target to another.

41. **LAMP TEST** control is a pushbutton lamp used to check for burned out bulbs on the display console.

CONTROL INDICATION	LAMP INDICATION	MEANING	REMARKS
AZIMUTH BLANKER/ACTIVE	Upper Section white. Lower Section OFF	Function Available to turn ON/OFF	Depress button once
	Upper Section white Lower. Section Green	In use	
FAULT/OVERTEMP	Upper Section Red	Failure in power supply	Depress MODE OFF and notify maintenance.
	Lower Section Yellow	Critical temperature rise detected; possible circuit damage.	Depress MODE OFF and notify maintenance.
TRACK SELECT	White	Function Available	Depress once to change close control tracking of one target to another tracked target.
LAMP TEST	White	Function Available	When depressed control lights all indicators and lamps simultaneously

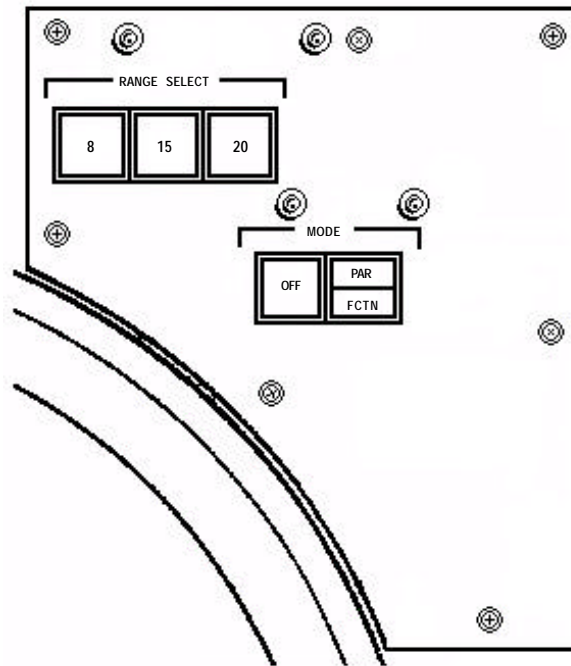


Figure 1-6. Top Right of Display Console.

42. **RANGE SELECT-8/15/20** control consists of three pushbutton lamps used to select anyone of three available ranges.

NOTE: Although 20 miles of radar are visible on the display, the twentieth range mark will not be seen.

43. **MODE-OFF/PAR/FCTN** controls consists of two pushbutton lamps used to select the operating mode of the display subsystem.

CONTROL INDICATION	LAMP INDICATION	MEANING	REMARKS
RANGE SELECT 8/15/20	White	Not Selected	Depress button once for desired range
	Green	Range Selected	
MODE-OFF/PAR FCTN	White	Display is OFF	Depress button once to turn on or off.
	Green	Display is in operation.	

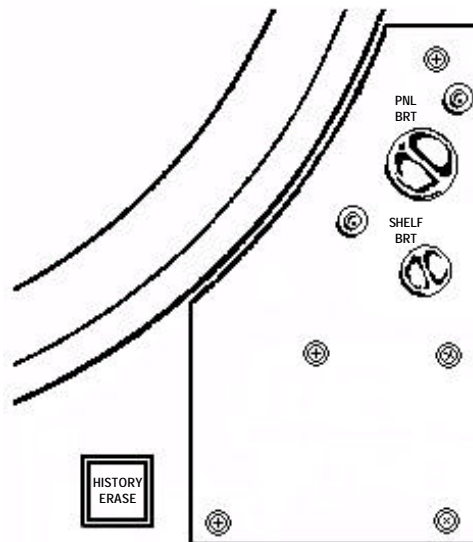


Figure 1-1. Bottom Right of Display Console.

44. **PNL BRT** control knob is used to vary the intensity of the lamps, indicators and edge light markings on the display console.

45. **SHELF BRT** control knob is used to vary the intensity of the lamps on the control panel.

NOTE: This control works only when the panel door is shut.

46. **HISTORY ERASE** control is a pushbutton lamp used to erase the history trail of a tracked target which is under close control.

CONTROL INDICATION	LAMP INDICATION	MEANING	REMARKS
HISTORY ERASE	White	Function Available	When depressed, the control erases the dotted history trail behind the target.
	Green	Erase Action ON	

47. The following controls are used to center, focus and vary the intensities on the display. Turn the knob clockwise to increase, and counterclockwise to decrease intensities.

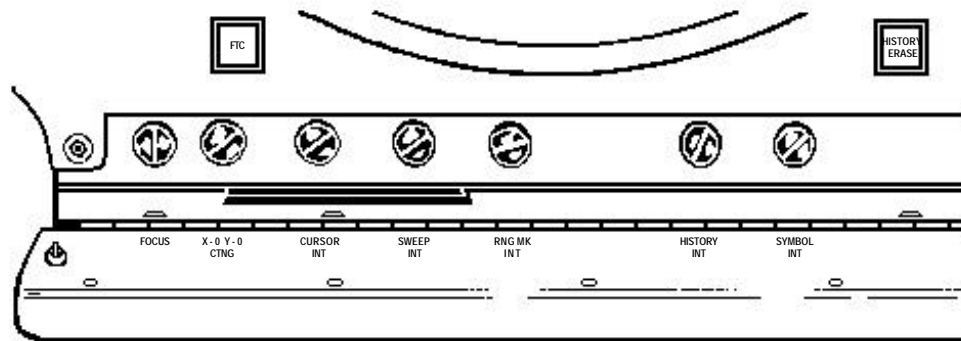


Figure 1-8 Bottom Center of Display Console.

FOCUS: Control knob is used to focus the display presentation.

X-0; Y-0 CTNG: Control knob is used to center the display presentation on the cathode ray tube.

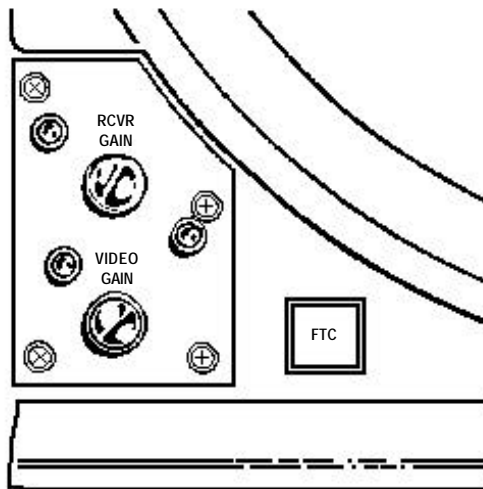
CURSOR INT: Affects glide path, lower safety cursor, decision height and courseline.

SWEEP INT: Adjusts minimum and maximum intensity of the sweep.

RNG MK INT: Adjusts minimum and maximum intensity of the range marks, every fifth range mark is intensified.

HISTORY INT: Adjusts minimum and maximum intensity of the target history trail.

SYMBOL INT: Adjusts minimum and maximum intensity of the target symbol.



48. **RCVR GAIN** control knob is used to adjust the snow level on the display. The gain may be increased to intensify weak targets or decreased to reduce heavy snow for better target definition.

CAUTION: Too much reduction of receiver gain will cause loss of scan targets.

49. **VIDEO GAIN** control knob is used to vary the intensity level of radar returns for both MTI and normal. This control should normally be set fully clockwise.

50. **FTC** control is a pushbutton switch-lamp which when activated reduces large blocks of video (heavy precipitation) to narrow video signals.

Figure 1-9. Bottom Left of Display Console.

CONTROL INDICATION	LAMP INDICATION	MEANING	REMARKS
FTC	White	Function Available to turn ON/OFF.	Depress button once
	Green	FTC Function ON	

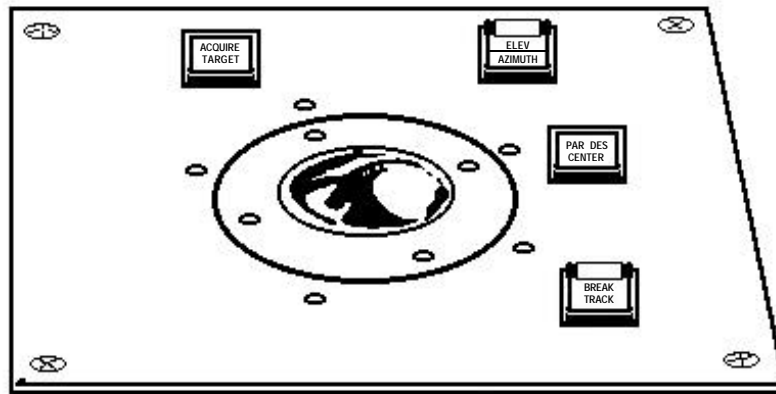


Figure 1-10. Track Control Panel.

51. **ACQUIRE TARGET** control is a pushbutton lamp used to begin close control tracking of the target over which the designate has been placed.

52. **ELEV AZIMUTH** control is a two position pushbutton lamp used to acquire in either elevation or azimuth. By pressing the desired function, the designate symbol will appear on either elevation or azimuth.

CAUTION: When selecting the Azimuth designated acquisition mode, you will not be able to acquire the reference reflector. The computer software supporting this mode will not allow the radar to search below an elevation of one (1) degree. The reference reflector is located at 0.8 or 0.9 degrees.

53. **PAR DES CENTER** control is a pushbutton lamp used to return the designate symbol to the left edge of the display. The left edge is considered the "idling" or centered position of the designate symbol.

54. **BREAK TRACK** control is a Pushbutton lamp used to terminate close control tracking of the selected target. When the BREAK TRACK control is depressed, the close control target symbol and the history trails will be canceled and the target will resume the status of an unselected target. The BREAK TRACK control is used when the aircraft has landed.

55. **TRACKBALL** moves in all directions and is used to position the DESIGNATE SYMBOL on the target selected for close control tracking.

CONTROL INDICATION	LAMP INDICATION	MEANING	REMARKS
ACQUIRE TARGET	White	Function Available	Depress button once to turn ON/OFF.
	Green	In Use	
ELEV-AZIMUTH	Upper Section Green	Designate in Elevation	Depress button to activate.
	Lower Section Green	Designate in Azimuth	
PAR DES CENTER	White	Function Available	Depress button to activate.
	Green	In Use	
BREAK TRACK	White	Function Available	Depress button to activate.
	Red	In Use	

SECTION D - CONTROL SYMBOLS

56. The following control symbols are used during performance checks and operations, and will appear on the display (See Figure 1-3) at various times.



57. Close Control Target Symbol. This symbol indicates the one tracked target under final approach control by the final controller. Upon receipt of a track status coast signal (loss of radar contact), this symbol begins to blink on and off.



58. Tracked Target Symbol. This symbol indicates the position (range, elevation, and azimuth) of a tracked target not under close control. Upon receipt of a track status coast signal, this symbol begins to blink on and off.

NOTE: This symbol indicates verified glide slope, decision height, Track Quality, Elevation Gusting Correction, Site Parameters and TDC-ABPC Data Bus faults. The tracked target symbol is as accurate as the close control target symbol.



59. Reference Reflector Symbol. This symbol indicates the position of the reference reflector and is displayed in azimuth only.



60. Designate Symbol. This symbol is used by the operator to select a target for tracking. The operator positions this symbol to correspond with the position of the desired target by rotating the trackball.



61. Reference Symbol. This represents an elevation angle corresponding to touchdown. It is positioned at touchdown on the elevation display.

CHAPTER 2

PROCEDURES

1. **PREOPERATION CHECKS.** The following checks should be completed before controlling aircraft on the HI-PAR. Check local directives for specific requirements.

a. **RADAR SET CONTROL**

- (1) Depress LAMP TEST and check for burned out lamp bulbs.
- (2) Check TRANSMITTER indicator lamps for proper settings. (All functions should be in low power unless already in the high power mode).
- (3) Check correct runway alignment on ANT FINE meter.
 - (a) Needle should be in green area or no more than + or - .5 degrees off, or
 - (b) Null indicator should read zero degrees (center position).
- (4) PAR Performance Check: Ensure your system is aligned and the radar track circuits are operating properly by performing a PAR Performance test as follows:

NOTE: Ensure HISTORY INT is turned down to prevent burning the CRT.

- (a) Ensure transmitter is in low power.
- (b) Select normal video.
- (c) Press PAR PERF/TEST.
- (d) Move the trackball designate symbol to the elevation and range location of the fixed reference reflector and press ACQUIRE TARGET. If the reference reflector is not acquired perform step e.
- (e) Press MARG PERF TEST. This causes the test conditions (power output) to be modified. If the reference reflector still cannot be tracked, the PAR is unusable. After completing this check, be certain to break track and press marginal PERF/TEST and PAR PERF/TEST to cause the lower half of the lamp to go out; otherwise, normal operations will not resume.

NOTE: A PAR performance check should be accomplished as soon as possible after assuming responsibility of the position, and periodically throughout your watch. Additionally, a check should be made after a runway change and any time the equipment is returned from maintenance.

- (5) Check TRACK MODE and verify both modes (NORM and BACKUP) are operational.
- (6) Ensure CLUTTER REJECT is set according to local requirements.
- (7) Adjust the RAIN REJ, RNG ADJ, VIDEO SELECT, and RNG GATE control for optimum presentation.

b. HI - PAR DISPLAY.

- (1) Depress LAMP TEST and check for burned out lamp bulbs.
- (2) Adjust RCVR GAIN to obtain optimum target strength.
- (3) Adjust VIDEO GAIN by turning fully clockwise.

NOTE: RCVR and VIDEO GAIN must be used to prevent loss of primary target returns. This is necessary to detect a shift in coincidence between the primary target and control symbol and to detect traffic transitioning the PAR coverage area not under your control.

- (4) Select desired range on RANGE SELECT control.
- (5) Verify/center display on CRT.
- (6) Verify decision height.
- (7) Verify glide slope.

2. RECEIVER ADJUSTMENTS. To obtain an optimum radar presentation, you should make use of all of the various video signals available. Your selection should be based on the aircraft's Range and the fixed and environmental conditions. Coherent MTI is normally gored out from touchdown to the limits of the ground clutter. The noncoherent MTI video is selected for ranges where rain squalls are present. These selections are made by adjusting the RAIN REJ, RNG ADJ, VIDEO SELECT AND RNG GATE controls on the RSC.

**RSC VIDEO - RAIN REJ
and VIDEO SELECT Controls**

VIDEO DISPLAYED

VIDEO SELECT - NORM
RAIN REJ (No affect)

Normal search video for entire range of display.

VIDEO SELECT - MTI
RAINREJ - OFF
(RNG GATE -No affect)

Coherent MTI video for entire range of display.

VIDEO SELECT - GATED MTI
RAINREJ - OFF

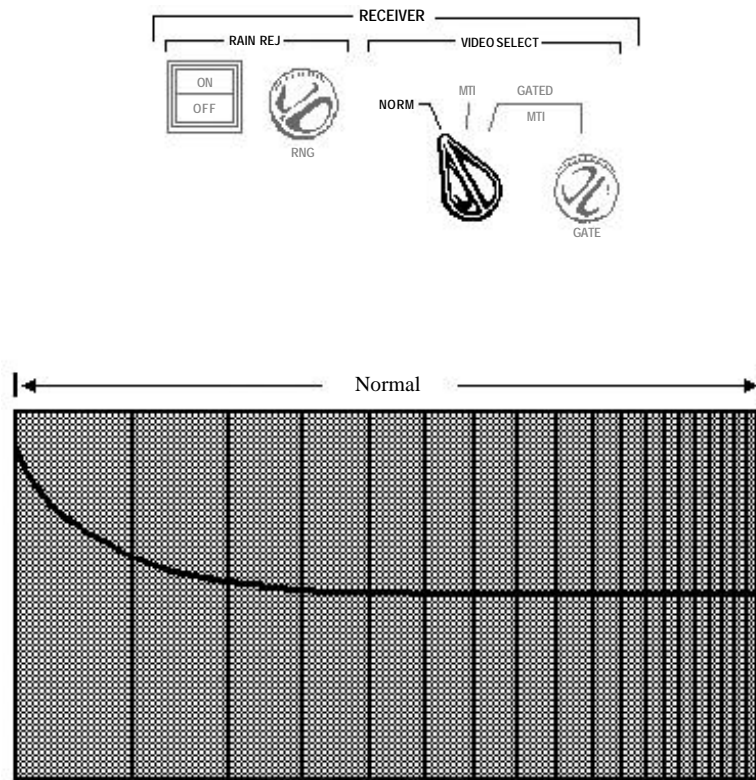
Coherent MTI video from touchdown out to range set by RNG GATE. Normal video from this point out.

VIDEO SELECT- MTI
RAINREJ - ON
(RNG GATE - No affect)

Coherent MTI video out to range set by RAIN REJ/RNG ADJ. Noncoherent video from this range on.

VIDEO SELECT - GATED MTI
RAINREJ - ON

Coherent MIT video from touchdown out to range set by RAIN REJ/RNG ADJ. Noncoherent MTI from this point out to range set by RNG GATE. Normal video displayed from this point out.

EXAMPLE 1

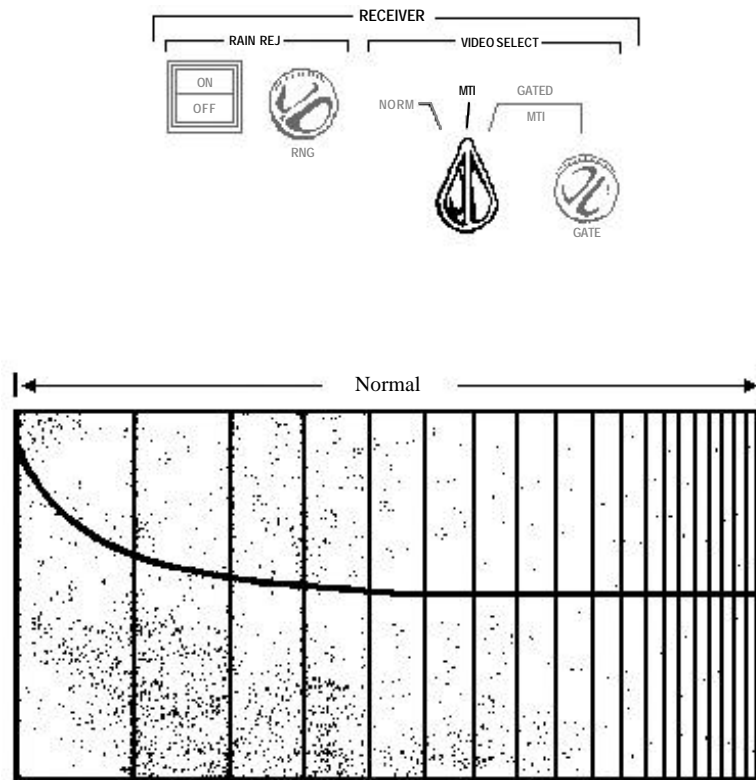
RCS VIDEO - RAIN REJ
AND VIDEO SELECT CONTROLS

VIDEO DISPLAYED

VIDEO SELECT - NORM
RAIN REJ- (no affect)

Normal search video for entire range of
display

Figure 2 - 1. Normal Search Video.

EXAMPLE 2

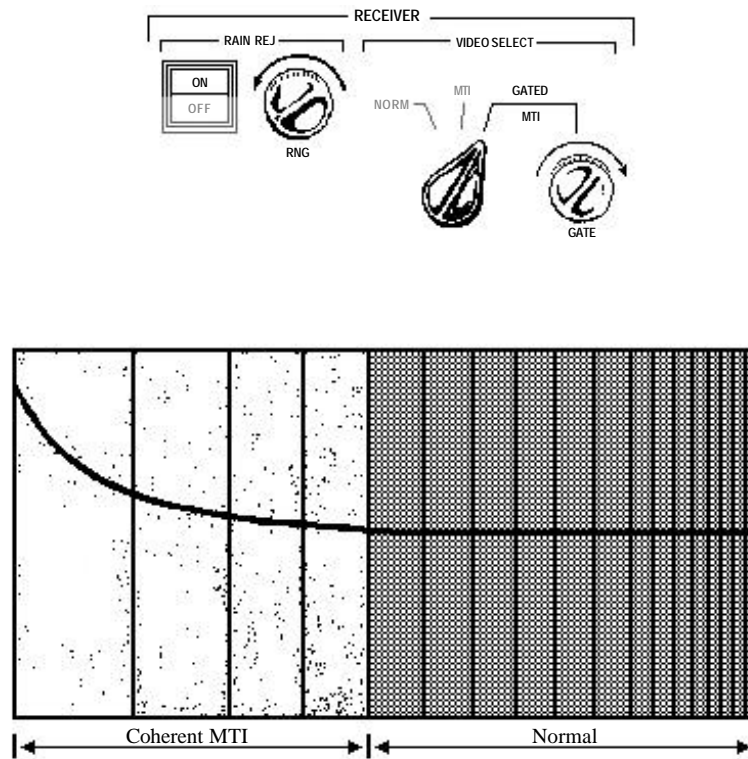
RCS VIDEO - RAIN REJ
AND VIDEO SELECT CONTROLS

VIDEO DISPLAYED

VIDEO SELECT - MTI
RAIN REJ-OFF
(RNG GATE -No affect)

Coherent MTI video for entire range of
display

Figure 2-2. Coherent MTI Video.

EXAMPLE 3

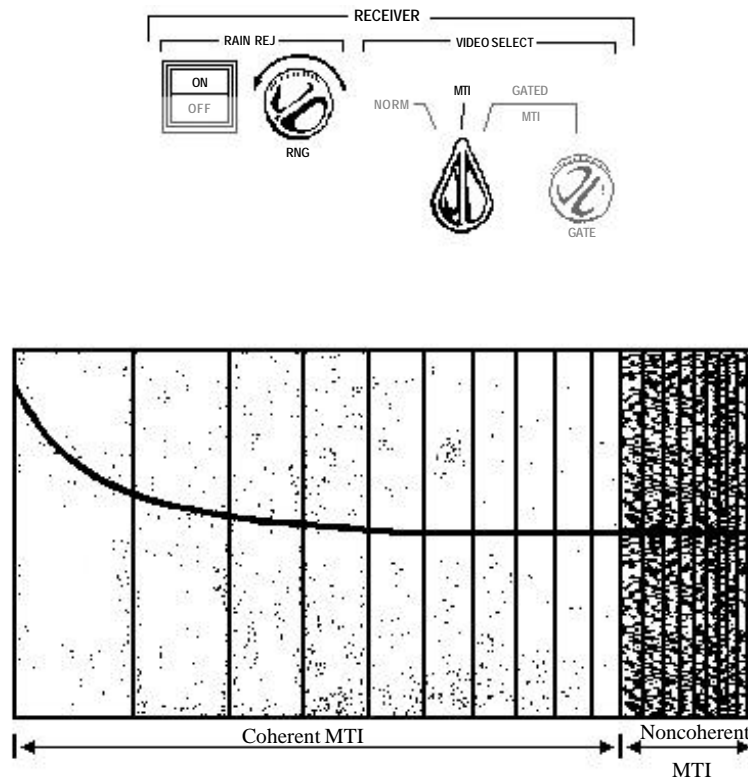
RCS VIDEO-RAIN REJ
AND VIDEO SELECT CONTROLS

VIDEO DISPLAYED

VIDEO SELECT - GATED MTI
RAIN REJ-OFF

Coherent MTI video from touchdown out to
the range set by the RNG GATE. Normal
video from this point out.

Figure 2-3. Normal Search Video and Coherent MTI.

EXAMPLE 4

RCS VIDEO-RAIN REJ
AND VIDEO SELECT CONTROLS

VIDEO DISPLAYED

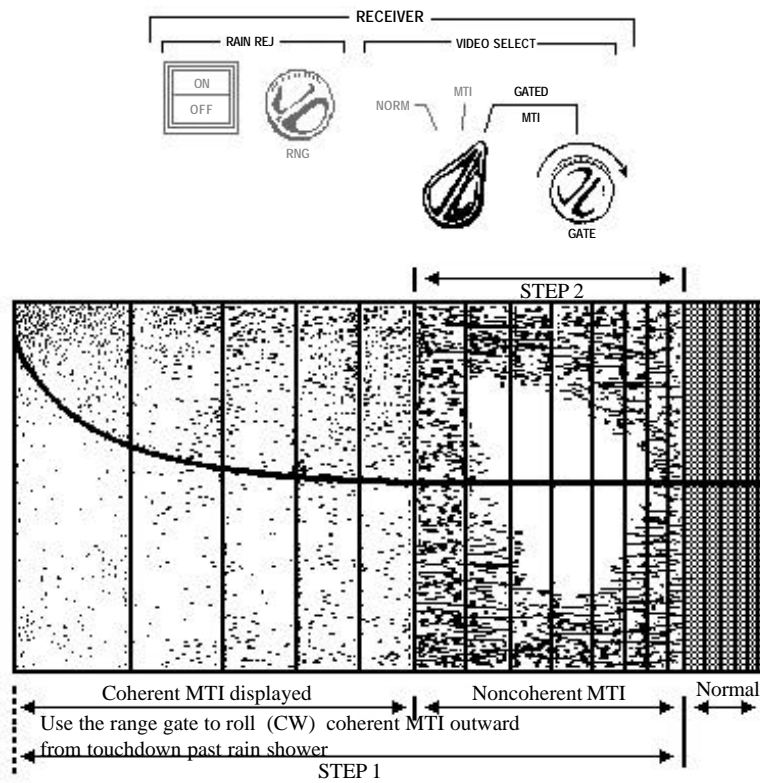
VIDEO SELECT - MTI
RAIN REJ - ON
(RNG GATE. No affect)

Coherent MTI video out to range set by
RAIN REJ, RNG ADJ. Noncoherent video
form this range on.

Figure 2-4. Coherent and Noncoherent MTI.

EXAMPLE 5

Use the range adjust to roll (CCW) noncoherent MTI from the point where coherent MTI is set towards touchdown to just passed the rain shower.



RCS VIDEO - RAIN REJ
AND VIDEO SELECT CONTROLS

VIDEO DISPLAYED

VIDEO SELECT - GATED MTI
RAINREJ - ON

Coherent MTI video from touchdown out to
range set by RNG GATE. Noncoherent MTI
from this point in to range set by RNG ADJ.
Normal video displayed form this point out.

Figure 2-5. Coherent and Noncoherent MTI and Normal Search Video.

3. **SETTING AND VERIFYING THE GLIDE SLOPE.** To set the glide slope for the runway in use, the following steps are required:

- a. Set the desired glide slope in the **GLIDE SLOPE COMMAND** window. A 3 degree glide slope will appear in elevation and a blinking fault symbol will appear at the location given in Table 2-1.
- b. Depress the **PAR DES CTR** to place the designate symbol to the left edge of the display.
- c. To verify the glide slope setting, ensure the **AZ -EL** button is in the elevation position, and then depress the **ACQUIRE TARGET** button.

(1) The new glide slope will appear in elevation.

(2) Verification of the new setting will be displayed in elevation using the range marks as units of measure. The following will occur simultaneously:

- (a) The first digit (2-5) of the glide slope will appear on the corresponding range mark (IAW Table 2-2). This will be a steady signal lasting 2.5 seconds.
- (b) The tenth portion of the glide slope (.0-.9) will also appear on its corresponding range mark (IAW Table 2-2). This will be a blinking track signal starting immediately after the steady signal and lasting 2.5 seconds. (The system will now automatically verify decision height).

NOTE:

1. This lets you know the new glide slope setting has been accepted into the system. If the blinking track fault symbol appears (IAW Table 2-1) on your display, the equipment is not set properly.
 2. If the glide slope setting is changed and not verified, it will automatically go to a 3 degree glide slope and indicate a fault. Each indicator must be verified separately.
- d. To verify the glide slope, repeat steps b. and c. of **SETTING AND VERIFYING THE GLIDE SLOPE**. Figure 2-6 shows an example of glide slope verification, you must observe that the symbols are on the range marks which correspond with the number of the desired glide path.

ELEVATION	AZIMUTH	RANGE	FAULT
- 1	-10	0	PAR 1 Unverified Glide Slope
- 1	-10	1	PAR 1 Unverified Decision Height
- 1	-10	4	PAR 2 Unverified Glide Slope
- 1	-10	5	PAR 2 Unverified Decision Height

Table 2-1. Unverified Indicator Fault us. Fault Symbol Position

NOTE: All information concerning verification is based upon the Version Eleven Operating Tape. If another version tape is used, the verification process will be different.

VERIFICATION SYMBOL	GLIDE SLOPE (Deg)		DECISION HEIGHT (ft)	
Range Marks (MNI)	UNITS	TENTHS	HUNDREDS	TENS
Condition (2.5)	Solid	Blinking	Solid	Blinking
Azimuth Location	-6	-2	+2	+6
Elevation Location				
PAR 1	2	2	2	2
PAR 2	8	8	8	8

Table 2-2. Glide Slope/Decision Height Verification Tracked Target Symbol Position

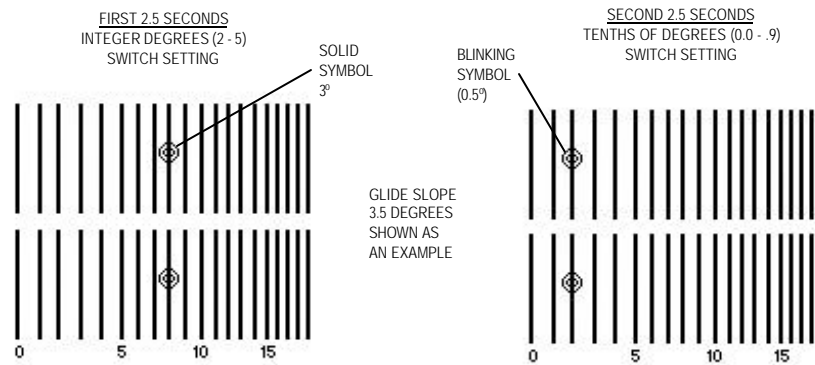


Figure 2-6. Glide Path Verification In Elevation.

4. **SETTING THE DECISION HEIGHT MARKER.** To set the decision height marker for the runway in use, the following steps are required:

a. Set the desired decision height in the **DECISION HEIGHT MARKER** window. The decision height marker will change to the new setting and a blinking track fault symbol will appear at the location given in Table 2-1.

b. Depress the **PAR DES CTR** switch to place the designate symbol to the left edge of the display.

c. Depress the **ACQUIRE TARGET** Switch. The following will occur simultaneously:

(1) Verification of the new setting will be displayed.

(2) The first 5 seconds will verify the glide slope and then the decision height altitude will be verified. The new decision height setting is verified in the same manner as the glide slope. The hundreds digit, 0-800, will be a steady signal for 2.5 seconds. The tens portion, 0-90, will be represented as a blinking signal lasting 2.5 seconds (see Table 2-2). This will verify that the decision height information has been properly set into the system.

d. To verify the decision height, repeat steps (2) and (3) of **SETTING THE DECISION HEIGHT MARKER**. Figure 2-1 shows an example of decision height verification, you must observe that the symbols are on the range marks which correspond with the numbers of the desired decision height.

NOTE: If the decision height setting is changed and not verified, it may automatically go to 100 feet and indicate a fault. Each indicator must be verified separately.

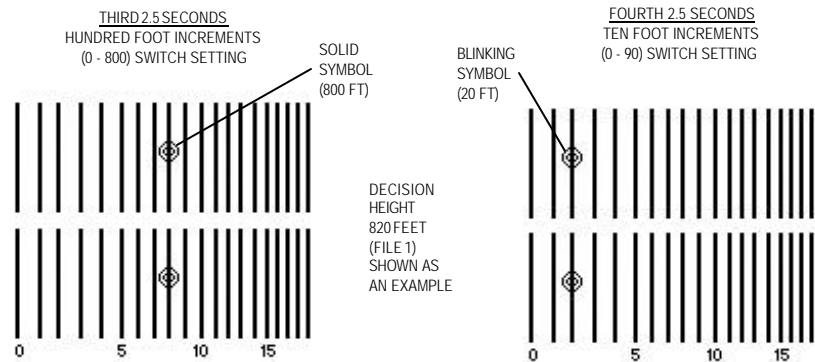


Figure 2-1. Decision Height Verification in Azimuth.

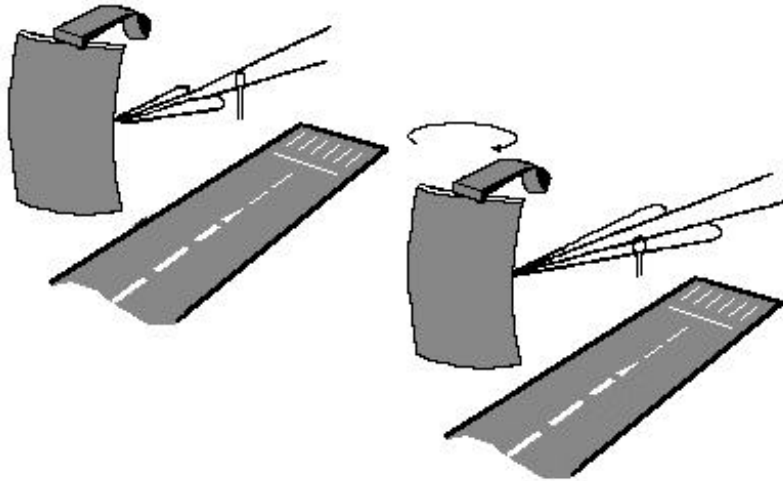
5. **RUNWAY CHANGE PROCEDURES.** To reposition the HI-PAR antenna to another preselected runway, follow these steps:

- a. Set the RUNWAY SELECT dial to the desired runway (1, 2, 3, of 4).
- b. Place the transmitter in LPWR or STBY.
- c. Use the CCW/OFF/CW toggle switch to rotate the antenna to the selected runway. Watch the ANTENNA POSITION meter until it indicates the correct antenna position.
- d. Continue holding the CCW/OFF/CW toggle switch until the antenna is centered. This is indicated when the ANTENNA FINE POSITION meter is centered.
- e. Perform a PAR performance check.

NOTE: If the antenna position meters are inoperative, maintenance personnel must manually align the antenna through the bore sight. Maintenance must place the antenna movement switch in the local position to prevent accidental rotation from the remote position.

Verify the glide path and decision height.

NOTE: Ensure you select PAR PERFORMANCE TEST before antenna rotation. This will reduce the sidelobes and decrease the possibility of a sidelobe locking on the reflector.



WARNING: Failure to select PAR PERFORMANCE TEST before antenna rotation may cause misalignment.

Figure 2-8. Antenna Rotation

6. **APPROACH LIGHTS/LANDING THRESHOLD IDENTIFICATION.** Determine the position of the approach lights and landing threshold by the following means:

a. For management:

(1) Have your unit TERPS specialist determine the position of the approach lights and landing threshold by computing the altitude of an aircraft on glide path at both points and enter these altitudes in the Decision Height Marker.

(2) Verify these points by flight check.

b. For others:

(1) Complete a facility indoctrination concerning the relation of these points in reference to your cursor and Decision Height Marker. Watch several runs and have your trainer point out these points on the indicator.

(2) Refer to the photographs/diagrams contained in your position ready reference file.

NOTE: Do not mark on your indicator with grease pencil.

7. **HI-PAR CONTROL TRANSFER.** Use the following procedures to transfer control of the HI-PAR radar between the OPS and HI-PAR segments:

a. Transfer from HI-PAR to OPS segment:

(1) Communicate by intercom with maintenance personnel in the HI-PAR segment.

(2) Activate LOCKOUT REMOTE ENABLE.

(3) Instruct the maintenance technician to activate the RDR CONT PAR/OPS pushbutton. The OPS section of the RDR CONT PAR/OPS will be lighted.

(4) Activate the LOCKOUT REMOTE ENABLE pushbutton. The lamp should change from green to white indicating control of the radar is at the OPS segment.

b. Transfer from OPS to HI -PAR segment:

(1) Communicate by intercom with maintenance personnel in the HI-PAR segment.

(2) Ensure transmitter status is the same at both PAR and OPS Radar Set Control (RCSs) before control is transferred.

(3) Activate the LOCK OUT REMOTE ENABLE pushbutton.

(4) Instruct the maintenance technician in the HI-PAR segment to activate the RDR CONT PAR/OPS pushbutton. The light should change from the OPS segment to the PAR segment on the RDR CONT PAR/OPS indicator. Control of the radar is now at the HI-PAR segment.

8. HOW TO ACQUIRE AND USE CLOSE CONTROL TRACKING.

- a. Determine which targets are to be selected for close control tracking.
 - b. Observe upper (CHAN AVAIL) position of CHAN AVAIL/ACQ ACTIVE indicator. When upper portion of indicator is lighted attempting to acquire a target.
- CAUTION:** If all channels are in use, you will be unable to verify the system. If a fault indication occurs, the sixth target acquired will lose all symbology and return to target scan video.
- c. Use the trackball to position the designate symbol in the path and slightly ahead of the selected target.
 - d. When the position of the designate symbol is slightly ahead of the selected target, press the ACQUIRE TARGET button. The following will occur simultaneously:

- (1) ACQUIRE TARGET lamp will light green while depressed.
- (2) Lower (ACE) ACTIVE) section of CHAN AVAIL/ACQ ACTIVE indicator will light green for approximately 4 seconds indicating the computer is responding to acquire target command.
- (3) Close control target symbol will be displayed on the leading edge of the target indicating the target is under close control tracking. **NOTE:** Coincidence of the close control target symbol and target can be adjusted by maintenance.
- (4) Target now under close control tracking will display history trail.
- (5) Any history trails previously on the display will be canceled.
- (6) If you used the last of the six channels available, both sections of CHAN AVAIL/ACQ ACTIVE indicator will extinguish.

- e. Adjust HISTORY INT control for desired intensity of the history trail.
- f. Determine whether FTC is needed.

NOTE: Where problems exist because of high ground clutter, both MTI and FTC should be used.

- g. If close control target is within 15 NM, display range may be reduced to 15 or 8 NM range.
- h. If close control of target is self terminated shortly after acquisition, attempt to reacquire the target; if unable, activate the BACKUP on the TRK MODE NORM/BACKUP CONTROL. Whether to continue without close control tracking symbology depends upon local policy.
- i. Select PAR PERFORMANCE 1, 2, or 3, for optimum target strength:
 - (1) The system will automatically start tracking on PAR PERFORMANCE 2. This provides a medium bandwidth for tracking targets under normal approach conditions. For optimum target strength you can select one of the other two available settings.
 - (2) PAR PERFORMANCE 1 provides the maximum bandwidth for tracking maneuvering aircraft.

(3) PAR PERFORMANCE 3 will provide a minimum bandwidth which increases the track receiver signal to noise level on targets making low approaches in areas of clutter.

NOTE: The PAR PERFORMANCE setting will automatically revert to the last setting used for the next aircraft on final once it becomes the number one aircraft.

9. **HI-PAR TARGET TRACKING PROCEDURE.** The HI-PAR radar uses a target data computer to track aircraft under close control. There are different procedures for disengaging close control tracking. The first method, BREAK TRACK, is used to disengage close control tracking without transferring to another target. The second method is the TRANSFER OF CLOSE CONTROL TRACKING TO A PREVIOUSLY UNSELECTED TARGET procedure. The term "unselected" refers to a target not under tracked target status. The third method is the TRANSFER OF CLOSE CONTROL TRACKING TARGET procedure using the TRACK SEL button. Use of either of the two "transfer" procedures will cause the target previously under close control to remain under track control. Use the following procedures to acquire, control and disengage close control tracking:

a. **BREAK TRACK (CLOSE CONTROL SYMBOL).** To break track of a target under close control, activate BREAK TRACK. The following will occur simultaneously:

- (1) BREAK TRACK lamp will light red while depressed.
- (2) Close control target symbol will not appear on display. Target formerly under close control will resume status of an unselected target. (Normal Radar Target).
- (3) History trails will be canceled.
- (4) Upper (CHAN AVAIL) section of CHAN AVAIL/ACQ ACTIVE will light, if previously extinguished.

b. **TRANSFER OF CLOSE CONTROL TRACKING TO A PREVIOUSLY UNSELECTED TARGET:**

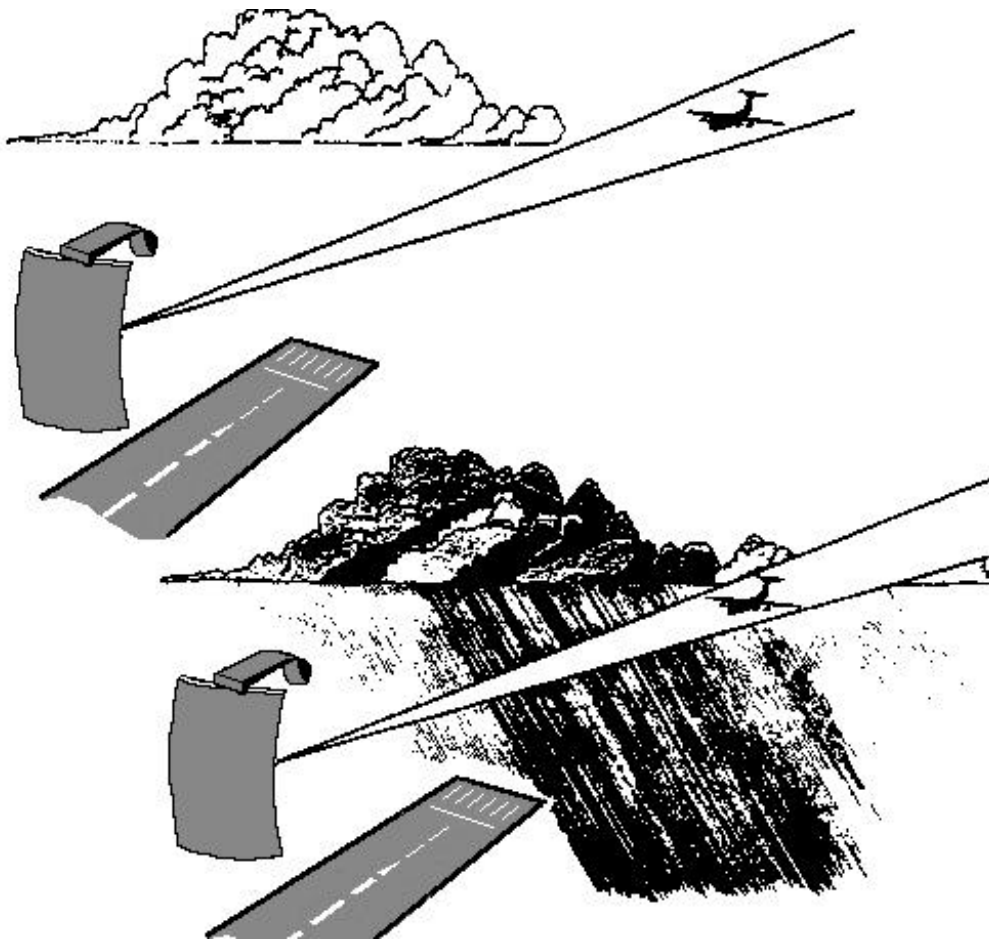
- (1) Using trackball, position designate symbol in the path of the aircraft selected for close control tracking.
- (2) The close control target symbol will indicate the target is under close control tracking.
- (3) Target not previously under close control will assume status of a tracked target and will display as such.
- (4) Target now under close control tracking will display history trail.
- (5) To return close control tracking to a previously selected target, use the Track Select Control.

c. **TRANSFER OF CLOSE CONTROL TRACKING TO A TRACKED TARGET.** Press TRACK SELECT pushbutton once. Target under close control may be one of up to five targets previously under track control. If target now under close control is not the target desired for close control, press track select until the selected tracked target is under close control.

10. **USE OF HIGH POWER (HPWR).** HIGH POWER is designed to burn thru rain showers on final and maintain tracking of selected aircraft. You must acquire your aircraft before it's positioned if or on the other side of the rain shower. If the rain shower is on final the aircraft should be acquired on base or dogleg.

NOTE: A five minute warm-up period is required to go from low to high power. If you've been in high power for over 5 minutes and go to low for 2 minutes, it will take an additional 2 minutes for high power to come back up. When high power is off for 5 minutes or more, a full 5 minutes is required.

AIRCRAFT MUST BE ACQUIRED BEFORE ENTERING RAIN SHOWER



AFTER THE AIRCRAFT IS ACQUIRED, HIGH POWER WILL BURN THROUGH THE RAIN SHOWER AND MAINTAIN A CONSTANT LOCK.

Figure 2-9. Use of HIGH POWER.

11. FORMATION APPROACHES. The GPN-22 is a leading edge tracking system which allows the close control track symbol to be assigned to the aircraft closest to the radar antenna regardless of its position within the flight (lead, #2, etc). During formation approaches, be prepared for one of the situations illustrated in figure 2-10 or 2-11. Your actions in either case should normally be limited to one of the following:

- a. Time permitting, acquire the remaining aircraft on final.
- b. Terminate the approach when advised of a "go around" or "missed approach."

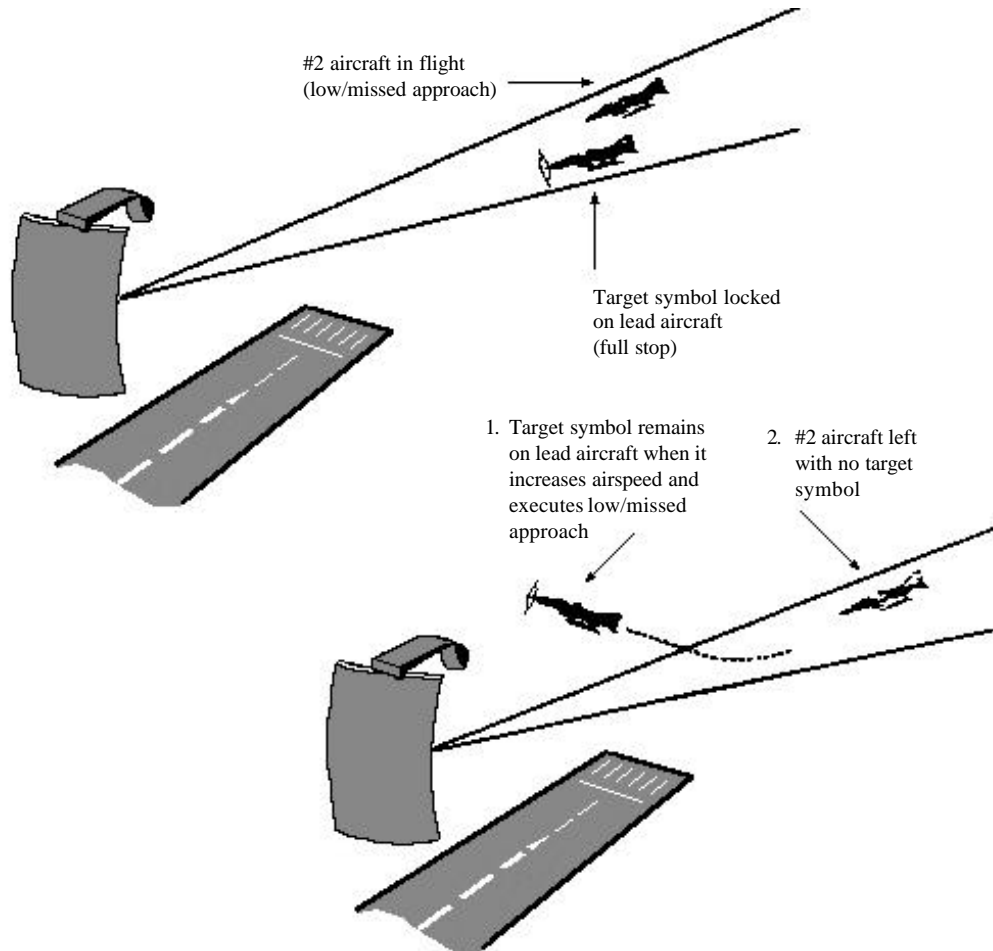


Figure 2-10. Loss of target symbol during formation approaches (lead aircraft go-around). The lead aircraft executes a missed approach and the close control target symbol remains on this aircraft leaving the remaining aircraft in an untracked status.

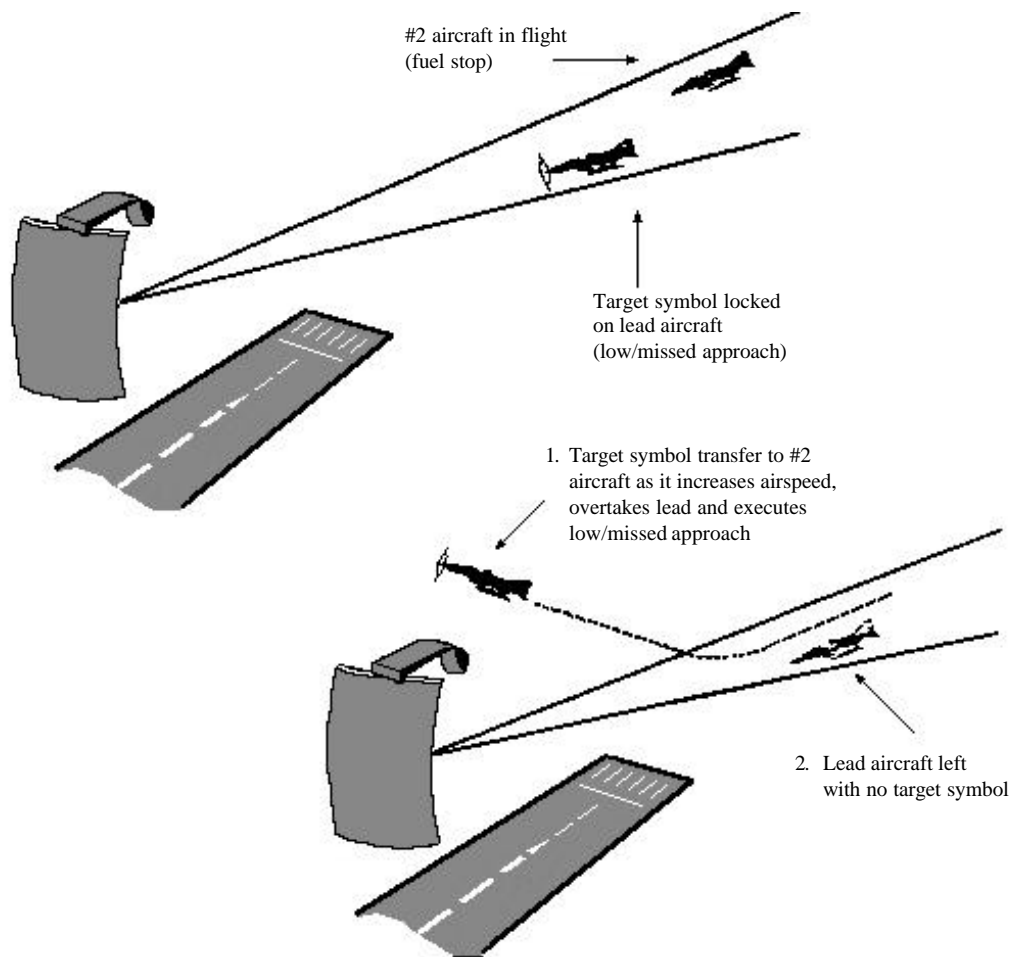


Figure 2-11. Loss of target symbol during formation approaches (lead aircraft landing). The second aircraft in the flight executes a missed approach. As it increases airspeed and overtakes the lead aircraft, the close control target symbol transfers to the aircraft on missed approach.

CHAPTER 3

EQUIPMENT MALFUNCTIONS

1. The following HI-PAR failure and malfunction procedures are in addition to those in Chapter I.

- a. Erratic tracking due re suspected computer program errors.

SOLUTION: Press TDC-INIT. This will cause all tracked targets to revert to an untracked status. If program errors are not eliminated, press TCD-LOAD PROGRAM to reload the Target Data Computer. After pressing the button, notify maintenance so they can reload the Target Data Computer tape reader. Verify indicator alignment/status.

- b. Erratic or loss of radar on one display.

SOLUTION: Turn MODE-OFF/PAR FCTN off. Transfer aircraft responsibility to another controller if possible. Notify maintenance.

2. **FAULT DETECTION:** The operational program for the radar set includes a fault detection capability to warn of either a change or error in certain critical reference data or a data bus fault. The position of the symbol on the display specifies which condition has been detected (See Table 3-1).

- a. **SITE PARAMETER FAULT:** A site parameter (s) received by TDC is different from that entered in site parameter panel when system was initialized.

b. **GLIDE SLOPE/DECISION HEIGHT CHANGE:** Indicates a change in glide slope angle or decision height. You should determine what glide slope and decision height are actually now present to make certain that the change is valid. If there has been a glide slope data failure, an automatic fault symbol and a 3 degree glide slope is displayed.

c. **ELEVATION GUSTING CORRECTION FAULT:** If a difference of 0.2 degree or more of elevation angle data is detected between reflector elevation angle as derived from vertical sensor and track reference reflector data, a fault exists. If the error is 0.2 to 0.3 degree the flashing symbol is shown. If the error exceeds 0.3 degree the glide slope cursor is automatically switched to 0 degree elevation angle and precision approach activities must be terminated immediately since elevation angle information is no longer available.

d. **REFERENCE TRACK QUALITY:** A fault exists if there is a low alarm rate (low track reflector detection rate), or a large error exists in range, azimuth, or elevation of track reference reflector.

e. **DATA BUS FAULT:** A failure in data transfer between She TDC and ABPC on the data interface bus in the radar set. This is checked automatically by a periodically repeated echo test which determines if data entered into the ABPC can be retrieved by the TDC unchanged.

Table 3 -1. Fault Type us. Fault Symbol Position

ELEVATION	AZIMUTH	RANGE	FAULT
-1	+10	0	Echo Test
-1	+10	1	SSP Data
-1	+10	2	Elevation Error
-1	+10	3	Poor Track Quality-Elevation
-1	+10	4	Poor Track Quality-Azimuth
-1	+10	5	Poor Track Quality-Range
-1	+10	6	Poor Track Quality-Alarm Rate
-1	+10	7	File 1 Unverified-Glide Slope
-1	+10	8	File 1 Unverified-Decision Height
-1	+10	9	File 3 Unverified-Glide Slope
-1	+10	10	File 3 Unverified-Decision Height

NOTE: All Fault Symbols Flash

File 1= PAR1

File 3= PAR2

NOTE: This table is usable when Version Eleven Operating Tape is in use. If another version tape is used, the fault will be different.

CHAPTER 4**HI-PAR OPERATING LIMITATIONS****1. Service Volume**

- a. Indicator Azimuth: + -10 degrees relative to boresight.
- b. Indicator Elevation: -1 to +7 degrees minimum relative to horizon.
- c. Range: 8, 15, or 20 NM on an average target for normal video.
- d. Runways: Service volume coverage may be changed to any one of four intersecting runways.

2. System Accuracies

- a. Azimuth: 0.2 degrees or 30 feet of true azimuth, whichever is greater.
- b. Elevation: 0.1 degree of true elevation.
- c. Range: 200 feet or 2 percent of true range, whichever is greater.

3. Registration Accuracy

- a. Azimuth: + -1.0 mrad.
- b. Elevation: + -0.5 mrad.
- c. Range: +- 200 feet or 1.5 percent of target slant range, whichever is greater.

4. Display

- a. Azimuth and elevation displays are combined on one 16 inch CRT. Elevation on upper half, azimuth on lower half; sector limiting to avoid overlapping and an expansion factor of 8X for elevation and 3X for azimuth.
- b. Information displayed: Normal video, noncoherent MTI, coherent MTI, range marks, cursors, and computer tracking data. Computer tracking symbols shown on page 21.
- c. Range marks: 1 NM intervals with 0, 5, 10, and 15 NM markers intensified.
- d. Electronic Map:
 - (1) Glide Slope Cursor: Glide slope selectable from 2 to 5 degrees in 0.1 degree increments.
 - (2) Safety Zone Cursor: Dashed cursor adjustable from 0 degree to 1 degree below selected glide slope in .1 degree increments.
 - (3) Decision Height Marker: Reference line intersecting glide slope cursor and safety cursor. Height selectable from 10 ft to 890 ft in 10 ft increments.

CHAPTER 5

TARGET DATA COMPUTER (TDC) 1A7

1. **Introduction.** The TDC, 1A7, replaces the tape reader with an Erasable Programmable Read Only Memory (EPROM) chip. User interface and operation for the controller is transparent. Refer to page 8, paragraph 20 and 21 for TDC operation.

NOTE: If your GPN-22 is equipped with the 1A7 TDC, the note to paragraph 21 is invalid.

2. **Purpose.** The TDC controls the beam pointing angle and is responsible for initiation of target search, acquisition and tracking functions. After target acquisition, it maintains track of aircraft in range, elevation and azimuth. The TDC also compensates for slant range, elevation and azimuth angle and transmits the proper data to the PAR display.

3. **Related Manuals.** T.O. 31P5-2T-112 provides technical information on the 1A7 TDC. While there should be no difference in use, local maintenance personnel can answer operational questions.